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Enhancement of 5-Aminolevulinic acid-induced oxidative stress by gold nanoparticles

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5-Aminolevulinic acid (5-ALA) and its methyl ester (5-ALA-Me) at mM concentration levels induce oxidative stress via the production of reactive oxygen species (ROS). Human cancer cell lines (MCF-7 mammary adenocarcinoma, HepG2 hepatocellular liver carcinoma, and A549 lung carcinoma cells) incubated in the dark in the simultaneous presence of 5.0 mM or more 5-ALA or 5-ALA-Me and 7 μg/mL of 15 nm citrate capped gold nanoparticles (AuNPs) were damaged more seriously compared to those in the presence of the levulinic acid alone. Damage (for MCF-7) is visible in electron micrographs which reveal similar morphology both in the presence or absence of AuNPs. Cytotoxicity was observed irrespective of the presence of serum and medium. Production of ROS in cell free samples containing 5-ALA-Me was monitored by EPR as the DMPO-OH spin adduct, and also showed a catalytic effect of AuNPs. Both SOD and CAT inhibited the production of ROS and also reduced cytotoxicity in the cell samples. These observations can be explained by initial attack on the cell membrane by ROS produced in the medium outside the cell and provide insight into possible uses of 5-ALA in cancer chemotherapy.